Survival in Acute Myocardial Infarction

Factors Observed in 318 Patients

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• **Factors influencing survival in a group of 318 cases of acute myocardial infarction were analyzed.**

The mortality rate for the entire series was 41 per cent. Among the men it was 39.5 per cent; among women, 44.4 per cent. The mortality rate increased with the age of the patient. Twenty-six per cent of all deaths occurred within the first 24 hours, 44 per cent within 72 hours, and 71 per cent within the first week following hospital admission.

Increased mortality rate was associated with previous history of congestive failure, myocardial infarction, hypertension or cardiomegaly. As to circumstances immediately preceding an infarction, the only ones that seemed to be related to a high mortality rate were hemorrhage and the postoperative state. Not only the presence but the degree of shock, congestive failure, cyanosis and dyspnea adversely influenced chances for survival. Duration, location, radiation and number of attacks of pain did not appear to be associated with extraordinary mortality rates. Anterior was slightly more common than posterior infarctions, and the mortality rate was much higher. Thromboembolic complications and certain disorders of rhythm and of conduction definitely worsen prognosis.

Comparison of average mortality data as reported in different studies on acute myocardial infarction is improper and misleading because of the great differences between the kinds of patients included in various series reported upon. A standard method of grading the severity of acute myocardial infarction would help toward sounder comparisons.

THE PRESENT STUDY is an analysis of factors which appear to influence mortality in acute myocardial infarction. It is based on data on 318 patients admitted to the California Hospital between the years 1949 and 1951, inclusive, in which the diagnosis could be established by unequivocal electrocardiographic evidence or by autopsy findings.

Of the 318 patients, 228 were men, 90 women. The age range was from 33 to 86 years (average 61); 83 per cent were 50 to 80 years old and about a third were 60 to 70 years old. The average age of the men was 60 years, and nearly half of them were younger. For the women the average age was 65.5 years and only a fourth of them were less than 60.

Mortality

The difference between the sexes in hospital mortality was not great—39.5 per cent for the men, 44.4 per cent for the women. The average for the series was 41 per cent.

Death rates on certain days following hospital admission are presented in Chart 1. Of 284 patients who survived the first 24 hours, 96 (33.8 per cent) died subsequently. Of the patients surviving the third day, 30 per cent died. Only 25 per cent of patients alive on the fifth day died during the time they were in hospital. Among those alive at the end of the first week, the mortality rate was only 16 per cent, and among those who survived the second week it was only 6 per cent. In other words, the mortality rate among the survivors decreased sevenfold within the first two weeks. It would appear that chances for recovery improved steadily with each day of survival after acute infarction.

While Chart 2 clearly indicates increase of mortality with age, there is also a suggestion—scanty though the data are—that in the fourth and fifth decades the mortality following myocardial infarction is higher in men than in women, while in the ninth decade this situation is reversed.

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Previous Illness

In agreement with other investigations, the data in Table 1 disclose a mortality of 61 per cent among patients who had had congestive failure—nearly twice as high as among the others. Mortality was likewise high following previous myocardial infarction and among patients with hypertension. Angina, obesity and diabetes mellitus did not appear to influence mortality in this series of cases.

Of the circumstances immediately preceding infarction which are listed in Table 2, only surgical operation and massive hemorrhage (usually gastrointestinal) appear to influence the outcome. Because of the small number with these complications, the

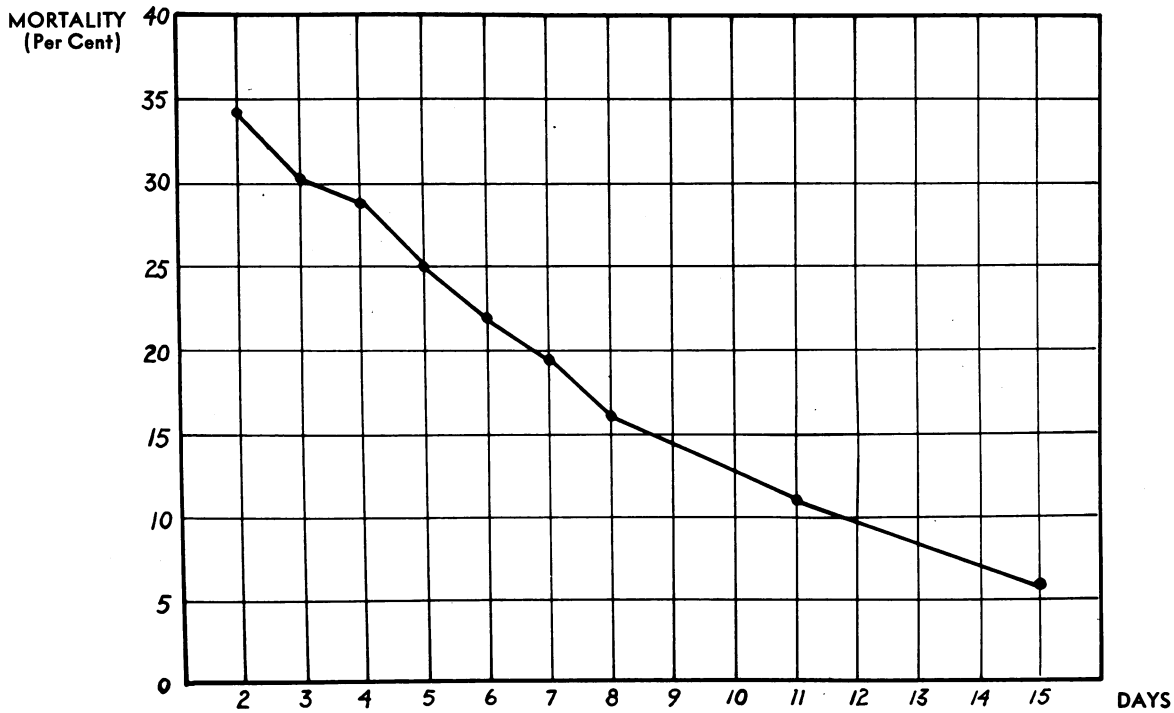

Chart 1.—Progressive decrease in mortality among survivors of acute myocardial infarction.

mortality rate associated with them—75 per cent—is not conclusive. Most infarctions occurred in patients at rest, and for these the mortality was practically the same as for the entire series, while the mortality rate associated with attacks following exertion was lower.

Signs and Symptoms During Hospitalization

Relationship of certain signs and symptoms to mortality is considered in Table 3. Our findings indicated that shock is an important factor — the greater the degree of shock, the poorer the prognosis. Fifty-two per cent of the patients in the series did not go into shock; in that group the mortality rate was 23 per cent. The mortality rate for patients in mild shock, moderate shock and severe shock was 32 per cent, 61 per cent and 84 per cent, respectively.

Not only the presence but the degree of congestive failure, too, influences outcome. The mortality rate among patients in whom congestive failure did not develop (54 per cent of the series) was only 21 per cent. With mild failure, the mortality rate was 23 per cent; with moderate failure, 70 per cent; and with severe failure, 83 per cent.

Cyanosis, particularly in moderate or severe disease, appears to be an ominous sign. This condition developed in 39 per cent of the patients in this series. In 12 per cent the cyanosis was mild; in 18 per cent, moderate; and in 9 per cent, severe. Mortality rates were 46 and 60 per cent in patients mildly and moderately cyanotic and 82 per cent when the degree of cyanosis was severe.

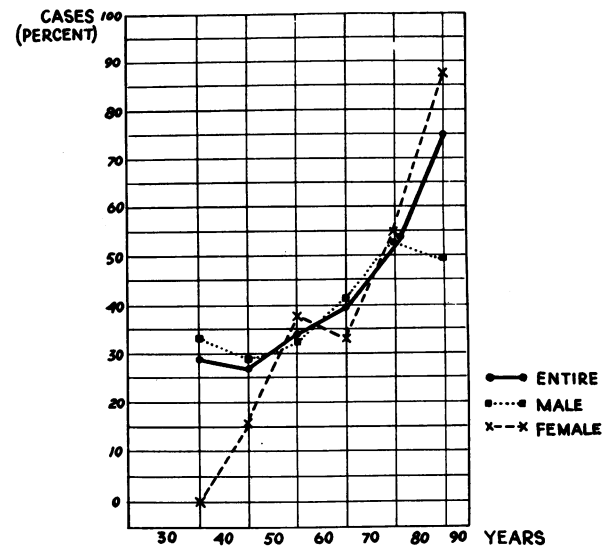

Chart 2.—Relation of age to mortality among 318 patients and for each sex.

Mortality rates associated with mild, moderate and severe degrees of dyspnea was 31 per cent, 54 per cent and 76 per cent, respectively. These observations are in general agreement with those of Rosenbaum and Levine,[10] who reported a mortality rate of 41 per cent in patients with dyspnea, in contrast with 18 per cent in patients with myocardial infarction without dyspnea.

TABLE 1.—*Presence or Absence of Certain Illnesses Before Acute Myocardial Infarction—Incidence and Relation to Mortality*

	Number of Cases	Illness Present		Illness Absent	
		Incidence (Per Cent)	Mortality (Per Cent)	Incidence (Per Cent)	Mortality (Per Cent)
Congestive heart failure	288	24	61	76	31*
Previous infarction	271	23	54	77	36†
Hypertension	294	27	52	73	35‡
Angina pectoris	286	51	37	49	38
Obesity	301	39	45	61	38
Diabetes mellitus	292	9	42	91	39
Vascular disease	292	16	50	84	38
Renal disease	295	12	51	88	39

*Significant at 0.1 per cent level. †Significant at 1 per cent level. ‡Significant at 5 per cent level.

Reliable information on cardiac size—based on roentgenographic or postmortem observation—was available in only 165 of the 318 cases. Of the 34 per cent without cardiac enlargement, 40 per cent died; of the 66 per cent with cardiomegaly, 71 per cent died.

Mild, moderate, and severe degrees of pain were associated with mortality rates of 21 per cent, 35 per cent and 40 per cent, respectively. No statistically significant relationship could be established between mortality and the location, radiation, duration or number of episodes of pain. Ten per cent of the patients in the series did not complain of pain; 73 per cent of that group died. Several of these patients, however, were in deep shock, stuporous or under the influence of narcotics, hence unable to report pain. If these were excluded and only conscious patients who denied pain on direct questioning were considered, the number of so-called "silent infarcts" would have been smaller and the mortality rate undoubtedly less.

Site of Infarction

Information as to the site of infarction, based on electrocardiographic and necropsy findings, was available in 313 cases (Table 4). Anterior infarction, particularly at the septum, had the poorer prognosis, and the mortality was likewise high for those patients with combined anterior and posterior infarctions.

Disorders of Rhythm and Conduction

Table 5 seems to indicate that auricular arrhythmias are actually associated with a lower than average mortality in myocardial infarction, while ventricular arrhythmias apparently worsen the prognosis, as do left auriculoventricular block and atypical bundle branch block.

TABLE 2.—*Circumstances Immediately Preceding Infarction—Relation to Mortality*

	Number of Cases	Incidence (Per Cent)	Mortality (Per Cent)
Hemorrhage	1	0.5	100
Postoperative state	11	6	73
Rest	105	55	42
Exertion	42	22	38
Meal	31	16	32
Emotion	2	1	0

TABLE 4.—*Mortality with Regard to Site of Infarction*

	Number of Cases	Incidence (Per Cent)	Mortality (Per Cent)
Anterior	85	27	34
Anteroseptal	36	11	81
Anterolateral	45	14	51
TOTAL ANTERIOR	166	52	49*
Posterior	101	32	21
Posteroseptal	10	3	70
Posterolateral	16	5	25
TOTAL POSTERIOR	127	40	24*
COMBINED ANTERIOR AND POSTERIOR	20	6	70

*Significant at 0.1 per cent level.

Thromboembolic Complications

Consistent with the thromboembolic nature of myocardial infarction is the high mortality, shown in Table 6, among patients with other evidence of a thrombotic tendency, particularly those with visceral and multiple emboli, all of whom died.

TABLE 3.—*Incidence of Certain Signs in Infarction—Relation to Mortality*

	Number of Cases	None		Mild		Moderate		Severe	
		Incidence (Per Cent)	Mortality (Per Cent)	Incidence (Per Cent)	Mortality (Per Cent)	Incidence (Per Cent)	Mortality (Per Cent)	Incidence (Per Cent)	Mortality (Per Cent)
Shock	311	52	23	15	32	18	61	15	84*
Congestive failure	311	54	21	11	23	20	70	15	83*
Cyanosis	300	61	25	12	46	18	60	9	82*
Dyspnea	305	40	16	14	31	25	54	22	76*
Cardiomegaly	165	34	40	....	....	61	71*	....	....
Severity of pain	290	10	73	5	21	18	35	67	40

*Significant at 0.1 per cent level.

DISCUSSION

Mortality rates in several series are illustrated in Table 7. As can be readily seen, they vary widely—from 3 per cent to 78 per cent. Such studies are not actually comparable for several reasons. In some series, patients dying within the first 24 hours after admission and patients who had had a previous attack were excluded. Some studies deal only with patients treated in private practice, others only with indigent patients, and still others a combination of the two. A perusal of these studies, as well as others, has suggested to us that investigators of survival in acute infarction can readily be classified as either "splitters" or "lumpers." The "splitters" have assembled a highly selective group of cases and presented attractively low mortality rates. The "lumpers" on the other hand have collected an assorted group of cases and have obtained an average mortality figure. Since it was apparent from early studies in prognosis that little could be learned from this method, many investigators came to divide their material into groups based on degree of severity as judged by clinical appearance, and then computed mortality rates for each group. The problem to date is that seldom have two investigators used the same criteria for grouping cases.

One method used to grade cases of acute myocardial infarction for prognostic purposes is the "good risk-bad risk" method of Russek and Zohman.[11] Applying their criteria to the data here presented, the authors found a 50 per cent mortality among the "poor risk" cases and a 10 per cent mortality among the "good risk" cases. However, among the "good risk" patients who died, there were four who, although they fulfilled the Russek-Zohman criteria, certainly could not be called bona fide "good risks": two were comatose and two had advanced carcinomatosis. Without these, the number of "good risk" cases was 72 and there were three deaths, or a mortality rate of 4 per cent. This compares favorably with Russek and Zohman's[11] report of a 3 per cent mortality in their "good risk" series. It may be concluded that if a patient is "good risk" at the time of admission to the hospital, survival from an acute attack can be predicted with a high degree of probability. This is in substantial agreement with the findings of the Committee on Anticoagulants[15] which concluded that the physician's appraisal of severity of a myocardial infarction at onset has high predictive value.

Schnurr[12] devised a semiquantitative method for grading the severity of acute myocardial infarction in which numerical values are assigned to clinical findings at the time of hospital admittance. The total number of points allotted to each case is its pathologic index reading (PIR). The authors have ap-

TABLE 5.—*Mortality with Regard to Disorders of Rhythm and Conduction in Infarction*

	Number of Cases	Incidence (Per Cent)	Mortality (Per Cent)
AURICULAR ARRHYTHMIAS			
Auricular tachycardia	6	2	33
Auricular fibrillation	20	7	30
VENTRICULAR ARRHYTHMIAS			
Ventricular tachycardia	6	2	67
Frequent ventricular premature contractions	22	6	55
AURICULOVENTRICULAR BLOCK			
1st degree	14	4	50
2nd degree	4	1	50
3rd degree	2	0.6	50
BUNDLE BRANCH BLOCK			
Right	11	3	27
Left	10	3	70
Atypical	7	2	86

TABLE 6.—*Mortality with Regard to Thromboembolic Phenomena in Infarction*

	Number of Cases	Incidence (Per Cent)	Mortality (Per Cent)
Phlembothrombosis	20	6	55
Embolism, cerebral	8	2	50
Embolism, peripheral	1	0.3	100
Embolism, pulmonary	16	5	87
Embolism, visceral	8	2	100
Embolism, multiple	6	2	100

TABLE 7.—*Mortality Rates for Acute Myocardial Infarction in Published Series*

Investigators	Year	No. of Cases	Type Service	No. of Attacks	Mortality (Per Cent)
Parkinson & Bedford[9]	1928	100	H, W, P	A	23
Levine & Brown[4]	1929	143	W, P	A	53
Conners & Holt[3]	1930	287	H, W, P	A	16.1
Master, et al.[6]	1936	267	H, W	1	16.5
Rosenbaum & Levine[10]	1941	208	W, P	1	33
Woods & Barnes[14]	1942	128	P	A	47
Newman[8]	1946	50	M	A	78
Mintz & Katz[7]	1947	572	H, W, P	1, 2	21.8
Smith, Keyes & Dunham[13]	1947	920	P	A	23.3
Billings, et al.[2]	1949	240	W	A	40.4
Baer, et al.[1]	1951	182	H	A	8.5
Russek & Zohman[11]	1951	1047	....	A	33.4
Russek & Zohman[11]	1951	489	....	1	3.1
Present series	1956	318	P	A	41.0

H—Home Patients W—Ward Patients P—Private Patients M—Military Personnel

TABLE 8.—*Distribution of Cases and Mortality Rates According to Pathologic Index Rating* in Three Series*

Pathologic Index Reading	Series					
	SCHNURR		PRESENT SERIES		LINKO	
	Cases	Mortality (Per Cent)	Cases	Mortality (Per Cent)	Cases	Mortality (Per Cent)
0 to 19	32	8	24	11	38	5
20 to 39	28	26	15	13		
40 to 59	20	35	19	34	34	17
60 to 79	12	82	18	63		
80 plus	8	95	24	77	38	55

*Pathologic index rating (by the method of Schnurr) is arrived at by assigning numerical values to various clinical findings at the time of admittance to hospital.

plied this method to the data herein presented and have compared it with a series of Schnurr[12] and also with a series of Linko,[5] a Finnish investigator. The distribution of PIR classifications in the three studies is shown in Table 8, and seems to demonstrate clearly the fallacy of comparing average mortality figures of different series because of the considerable inequality of severely ill patients in each group. For instance, in the series here reported there are three times as many critically ill patients as in Schnurr's group, and in Linko's series there are nearly five times as many. Table 8 also shows mortality rates in the different PIR groups in the three series. In all three there is a progressive rise in mortality rates associated with a rise in the PIR. This suggests that a semiquantitative rating system may be feasible.

Review of the literature brings out impressively the need for some standard method of grading acute myocardial infarction—a method which would be used by most investigators. Tumors, hypertension and rheumatoid arthritis have been classified for prognostic purposes with fair success; why not heart attacks? If some method of classification were generally accepted, it would not only augment knowledge of the natural history of the disease but would supply valuable control data for future investigations of therapeutic agents.

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